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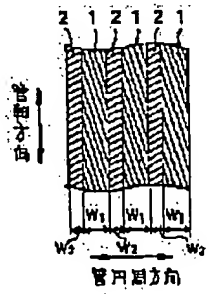
(71)Applicant: KOBE STEEL LTD
(72)Inventor: ISHIKAWA MAMORU
KOSEKI KIYONORI
HINAKO NOBUAKI
NOGUCHI MASATAKA

(54) HEAT TRANSFER TUBE WITH INNER SURFACE GROOVE

(57)Abstract:

PROBLEM TO BE SOLVED: To permit the obtaining of a high heat exchanging performance even under the condition of energy saving operation, in which the flow rate of refrigerant is small.
SOLUTION: A heat transfer tube with inner surface groove is made by a method wherein a plurality of grooves are formed on one side of the strip of a metallic sheet through rolling and a tube is formed so as to keep the surface, on which the grooves are formed, at the inside, then, the abutted ends are connected through welding. Two kinds of groove groups 1, 2 having different pitches in the circumferential direction of the tube, having different twisting directions or having different twisting angles are arranged alternately in areas having different widths W1, W2 in the circumferential direction of the tube. Further, the grooves having small twisting angle are formed on the area having wide width. When the width of the wider area is represented by a notation W1 and that of the narrower area is represented by another notation W2, it is specified that W1/W2=1.1-3.0. On the other hand, the smaller twisting angle is 40-20° and the larger twisting angle is 15-90° .



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(71)出願人　000001199
株式会社神戸製鋼所
兵庫県神戸市中央区脇浜町1丁目3番18号

(72)発明者　石川　守
神奈川県秦野市平沢65番地　株式会社神戸製鋼所秦野工場内

(72)発明者　小関　清憲
神奈川県秦野市平沢65番地　株式会社神戸製鋼所秦野工場内

(72)発明者　日名子　伸明
神奈川県秦野市平沢65番地　株式会社神戸製鋼所秦野工場内

(74)代理人　弁理士　藤巻　正憲

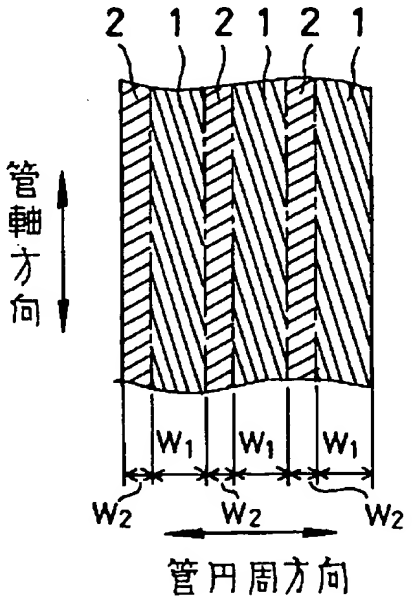
最終頁に続く

(54)【発明の名称】内面溝付き伝熱管

(57)【要約】

【課題】　冷媒流量が少ない省エネルギ運転条件下においても、高い熱交換性能を得ることができる内面溝付き伝熱管を提供する。

【解決手段】　金属板条材の一方の面に複数の溝を圧延成形し、この溝形成面を内側にして管状に成形し、突き合わせ端部を溶接接合して製管された内面溝付き伝熱管である。前記溝は、管円周方向の溝ピッチが異なるか、捻れ方向が異なるか、又は捻れ角度が異なる２種の溝群１、２が、管円周方向に異なる幅W_1、W_2の領域に交互に配置されたものである。また、幅が広い領域には捻れ角度が小さい溝が形成されている。更に、幅が広い方の領域の幅をW_1、幅が狭い方の領域の幅をW_2としたとき、$W_1/W_2=1.1$乃至3.0である。更に、前記捩れ角度は小さい方が４乃至２０°、大きい方が１５乃至９０°である。



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【特許請求の範囲】

【請求項１】　金属板条材の一方の面に複数の溝を圧延成形し、この溝形成面を内側にして管状に成形し、突き合わせ端部を溶接接合して製管された内面溝付き伝熱管において、前記溝は、管軸方向に対する捩れ角度が異なると共に捩れ方向が異なる２種以上の溝群が、管円周方向に異なる幅の領域に交互に配置されたものであり、前記幅が広い領域には捻れ角度が小さい溝が形成されていることを特徴とする内面溝付き伝熱管。

【請求項２】　前記溝群は２種類であり、幅が広い方の領域の幅をW_1、幅が狭い方の領域の幅をW_2としたとき、W_1/W_2が１．１乃至３．０であることを特徴とする請求項１に記載の内面溝付き伝熱管。

【請求項３】　前記溝群は２種類であり、前記捩れ角度は、小さい方が４乃至２０°、大きい方が１５乃至９０°であることを特徴とする請求項１又は２に記載の内面溝付き伝熱管。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明はルームエアコン等の熱交換器に使用する内面溝付き伝熱管に関し、冷媒流量が少ない省エネルギ運転条件でも高熱交換性能を有する内面溝付き伝熱管に関する。

【０００２】

【従来の技術】ルームエアコン等の熱交換器に使用する内面溝付き伝熱管として、金属管の内面に複数種の溝を形成して熱交換性能を向上させたものが公知である（特開平３－１３７９６、特開平４－１５８１９３号公報）。

【０００３】これらの従来技術のうち、特開平３－１３７９６号公報においては、管内面に管の内周を４以上の偶数で分割する形で管軸に対し互いに逆向きの角度を有する螺旋溝を形成させてなる伝熱管が開示されている。そして、前記螺旋溝が一定ピッチで形成されると共に、管軸方向に適宜間隔で溝を有しない平坦部が設けられている。この従来の内面溝付き伝熱管においては、ヘアピン加工による溝の逆転に起因する性能低下が防止され、凝縮時の凝縮液の集液作用により管内の液膜厚が平準化し、更に溝交差部からの液の離脱が促進されて凝縮性能が向上するという効果を奏する。

【０００４】また、特開平４－１５８１９３号公報においては、管内面へ管軸方向に沿い所定幅で複数種の凹凸群を形成した伝熱管が開示されている。この凹凸群は、凹凸が並行であり、且つ凸条と溝とが交互に位置するものである。また、一の凹凸群と、当該凹凸群に隣り合う凹凸群とは、溝ピッチ、溝寸法、溝形状及び溝の管軸方向に対するリード角の各要素のうちのいずれか一以上の要素を異にしている。更に、前記凹凸群が三つ以上とした場合が開示されている。この従来技術においては、管内の冷媒の流れを撹乱して伝熱性能を高めるという効果

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が記載されている。

【０００５】

【発明が解決しようとする課題】しかしながら、これらの従来技術においては、以下に示す欠点がある。先ず、特開平３－１３７９６号公報においては、伝熱管内に互いに逆向きの角度を有する螺旋溝を設けた場合、冷媒流量が少ない運転条件で蒸発器として使用すると、冷媒液が管内全体に均一に広がらず、熱交換性能が低下するという問題点がある。

【０００６】また、特開平４－１５８１９３号公報においても、伝熱管内に互いに逆向きの角度を有する螺旋溝を設けた場合、冷媒流量が少ない運転条件で蒸発器として使用すると、冷媒液が管内全体に均一に広がらず、熱交換性能が低下する。一方、同一方向の角度を有する螺旋溝を設けた場合、凝縮時に凝縮液の集液効果が低下し、伝熱面が凝縮液に覆われて熱抵抗となって熱交換性能を低下させてしまう。

【０００７】本発明はかかる問題点に鑑みてなされたものであって、冷媒流量が少ない省エネルギ運転条件下においても、高い熱交換性能を得ることができる内面溝付き伝熱管を提供することを目的とする。

【０００８】

【課題を解決するための手段】本発明に係る内面溝付き伝熱管は、金属板条材の一方の面に複数の溝を圧延成形し、この溝形成面を内側にして管状に成形し、突き合わせ端部を溶接接合して製管された内面溝付き伝熱管において、前記溝は、管軸方向に対する捩れ角度が異なると共に捩れ方向が異なる２種以上の溝群が、管円周方向に異なる幅の領域に交互に配置されたものであり、前記幅が広い領域には捻れ角度が小さい溝が形成されていることを特徴とする。

【０００９】前記溝群が２種類の場合、幅が広い方の領域の幅をW_1、幅が狭い方の領域の幅をW_2としたとき、W_1/W_2＝１．１乃至３．０にすることが好ましい。なお、このW_1、W_2は溝が形成された管内面における周長である。

【００１０】また、前記溝群を２種類としたとき、前記捩れ角度は小さい方が４乃至２０°、大きい方が１５乃至９０°であることが好ましい。

【００１１】本願発明においては、溝の捻れ方向及び管軸方向に対する捻れ角度が相違する２種類以上の溝群を、管円周方向に幅が異なる領域に交互に配分することにより、蒸発時に冷媒液が管内全体に広がり易く、更に乱流効果も生じるため、冷媒流量が少ない運転条件でも高い熱交換性能が得られる。

【００１２】一方、凝縮時は凝縮液の集液作用が生じ、伝熱面が常に冷媒ガスと接触して連続的な凝縮が起きる。更に、捩れ角度が大きい部分では重力による液排出が促進されるため、冷媒流量が少ない条件でも高い熱交換性能が得られる。

【００１３】
【発明の実施の形態】以下、本発明の実施例について、添付図面を参照して具体的に説明する。図１は本発明の実施例に係る内面溝付き伝熱管の正面図、図２はその内面溝を示す伝熱管の展開図である。伝熱管１０の内面には、２種類の溝群１、２が形成されている。即ち、図２に示すように、溝群１は管軸方向に対する捻れ角が小さい溝の集合体であり、溝群２は管軸方向に対する捻れ角が溝群１よりも大きな溝の集合体である。これらの溝群１、２は管円周方向に管内面における周長で夫々W_1、W_2（$W_1 > W_2$）の領域に形成されている。また、図１に示すように、溝群１の管円周方向の溝ピッチは溝群２の管円周方向の溝ピッチよりも小さい。各溝群１、２は管円周方向に交互に配置されているが、管軸方向には連続して形成されている。但し、伝熱管１０には、フィンを連結するために、管軸方向に適宜間隔で溝を有しない平坦部が設けられることがある。

【００１４】このような溝形状は、金属条板材の一方の面に、図２に示すような溝形状を圧延成形により転写し、この金属条板材をその溝形成面を内側にして管状に成形し、更に突合せ端部を溶接接合することにより、製造することができる。

【００１５】次に、上述のごとく構成された内面溝付き伝熱管の作用について説明する。先ず、伝熱管を蒸発器として使用する場合、伝熱管内には冷媒液が供給される。そこで、図２に示すように、伝熱管内面に形状要素（溝ピッチ、捻れ角度又は捻れ方向）が異なる溝を管円周方向に異なった加工幅で配分すると、冷媒液は円周方向の加工幅が広い溝形状の影響を受け、当該溝の捩れ角に沿った旋回流となって伝熱管内壁全体に広がり、蒸発性能が高くなる。

【００１６】この場合に、幅が広い溝形成領域における溝の管軸方向に対する捩れ角が小さいと、冷媒液の流量が少ない低流速条件下でも旋回流が生じ易く、更には溝形状が異なる幅が狭い領域においては乱流を伴うため、高い蒸発性能が得られる。

【００１７】一方、伝熱管を凝縮器として使用する場合、伝熱管内には冷媒ガスが供給される。冷媒ガスは伝熱管内壁全体で凝縮して液化する。このとき、液化初期の凝縮液は流れの慣性が小さいため、幅が狭い溝形成領域の溝によって旋回流が抑制される。この結果、凝縮した液が伝熱面全体を覆うことが防止され、伝熱面は常に冷媒ガスと接触して連続的な凝縮が生じ、凝縮性能が高くなる。

【００１８】この場合に、溝の捩れ角が大きい領域では、重力により伝熱管の下方側に凝縮液が排出され易く、冷媒液の流量が少ない低流速条件下でも高い凝縮性能が得られる。

【００１９】而して、管円周方向の幅が広い溝形成領域の前記幅をW_1、狭い領域の前記幅をW_2とすると、W_1/W_2が１．１未満では、蒸発時の冷媒流速が少ない条件下では、冷媒流が方向の異なる溝により相殺されて旋回流が生じ難くなり、蒸発性能は低下してしまう。一方、W_1/W_2が３．０を超えると、凝縮時に幅が広い溝形成領域の溝に沿って凝縮液の旋回流が生じ易くなり、伝熱面の埋没が生じて凝縮性能が低下する。従って、W_1/W_2は１．１乃至３．０であることが好ましい。

【００２０】
【実施例】以下、本発明の内面溝付き伝熱管を実際に製造し、その伝熱性能を本発明からはずれる比較例と比較した結果について説明する。銅板の一方の表面に、深さ０．２mm、溝直角断面での溝ピッチを０．２mmとした台形状の溝を、板幅方向に管円周方向の加工幅比に相当させて、W_1/W_2が１．０～３．５、幅W_1の領域の溝の捩れ角を３°、７°、２０°、幅W_2の領域の溝の捩れ角を１５°、２０°、６０°、９０°とし、W_1の領域とW_2の領域とを３対設けた。溝の成形はロール圧延にて行い、その後、溝加工面を内側にして板を幅方向に丸めながら板幅端部を突き合わせて溶接し、外径７．０mmの伝熱管を製作した。

【００２１】上記伝熱管を長さ３０００mmの二重管式熱交換機の内側に配置し、伝熱管の管内に冷媒を通流し、伝熱管と外管との間の環状部に水を通流して熱交換し、伝熱性能を測定した。

【００２２】外径７．０mmの銅管を用いた熱交換器では、定格能力運転時の冷媒流量は約３０kg／hであるが、今回は定格条件以下の冷媒流量２０kg／hで実施した。

【００２３】図３は蒸発試験、図４は凝縮試験結果を示すものであり、いずれも横軸にW_1/W_2をとり、縦軸に図３は蒸発性能、図４は凝縮性能をとって各性能を示すグラフ図である。図３、４において、実施例１乃至６及び比較例１乃至２は、下記表１に示す捩れ角（W_1部及びW_2部）を有するものである。

【００２４】
【表１】

		W_1部振れ角（°）	W_2部振れ角（°）
実施例	1	7	15
	2	7	20
	3	7	60
	4	7	90
	5	20	60
	6	20	90
比較例	1	3	15
	2	3	60

【００２５】図３から明らかなように、蒸発時にはW_1／W_2が１．１を超えると、冷媒に旋回流が生じて、W_1／W_2が１．０の場合よりも性能が向上する。特に、溝形成領域が広いW_1の領域に捩れ角度が７～２０°の溝を配置した場合に、高い蒸発性能を示した。

【００２６】一方、幅が広い溝形成領域$_1$に捩れ角度が３０°の溝を配置すると、上記の場合よりも蒸発性能は低下する。この原因は捩れ角度が３０°と大きい場合には、冷媒流量が少ない条件下では冷媒の旋回流が生じ難くなって、伝熱管上部が乾いた状態になり易いためである。

【００２７】一方、図４から明らかなように、凝縮時にはW_1／W_2が３．０以下の範囲では高い性能を維持し、W_1／W_2が３．０を超えると性能低下が顕著となる。凝縮時には幅が広い溝形成領域W_1に捩れ角度が大きい溝を配置すると、高い凝縮性能が得られる傾向にあり、この領域に捩れ角度が３０°の溝を配置した場合が最も高い性能を示した。

＊【００２８】最近のエアコンは冷暖房兼用が主流であり、伝熱管の性能は蒸発及び凝縮の双方が共に高いものが要求される。このため、上記実施例から管円周方向の幅が広い方の溝形成領域の幅をW_1、狭い方の溝形成領域の幅をW_2とするとき、W_1／W_2＝１．１～３．０とし、広い領域の溝捩れ角度を４～２０°、狭い領域の溝捻れ角度を逆方向の捻れで１５～９０°とすることが好ましい。

【００２９】W_1／W_2については、蒸発及び凝縮のいずれも高い性能を得るために、好ましくはW_1／W_2＝１．５～２．５とするのが良い。図５及び図６は縦軸に蒸発性能又は凝縮性能をとり、横軸に冷媒流量をとって、夫々蒸発試験及び凝縮試験の結果を示すグラフ図である。図中に示す実施例７、比較例３、４は、下記表２に示す捩れ角（W_1部及びW_2部）を有する。

【００３０】

【表２】

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		W_1部捩れ角	W_2部捩れ角	W_1／W_2
実施例	7	右7°	左60°	2．0
比較例	3	右15°	左15°	1．0
	4	右15°	右15°	1．0

【００３１】図５、６に示すように、本願発明の実施例７は、W_1／W_2が請求項２の範囲から外れる比較例３、４に比して、蒸発性能及び凝縮性能がいずれも優れている。

【００３２】前述のように、従来、外径７．０mmの銅管を用いたエアコン等の熱交換器では、定格能力運転時の冷媒流量は約３０Ｋｇ／ｈで設計されていた。しかし、近時、省エネルギ及び高効率化の点から、圧縮器の動力負荷低減が要求されている。この場合は、冷媒流量が少ない運転条件で従来の定格能力を得ることが必要になるが、本願発明に係る内面溝付き伝熱管は、上述のごとく、冷媒流量が２０ｋｇ／ｈという少ない運転条件下で高性能が得られるため、熱交換器の省エネルギ及び高効率化に著しい貢献をなす。

【００３３】

【発明の効果】以上説明したように、本発明に係る内面溝付き伝熱管は、ルームエアコン等の熱交換器に使用すると、冷媒流量が少ない省エネルギ運転条件下でも高い熱交換性能が得られる。このため、本発明は近時の熱交換器の省エネルギ化及び高効率化の要請に多大の貢献をなす。

【図面の簡単な説明】

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【図１】本発明の実施例に係る内面溝付き伝熱管の正面図である。

【図２】同じくその溝形状を示す伝熱管の展開図である。

【図３】蒸発性能を示すグラフ図である。

【図４】凝縮性能を示すグラフ図である。

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【図５】蒸発性能を示すグラフ図である。

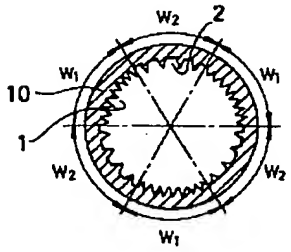
【図６】凝縮性能を示すグラフ図である。

【符号の説明】

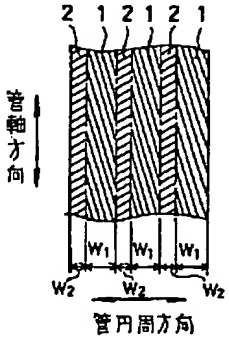
１、２：溝群

１０：伝熱管

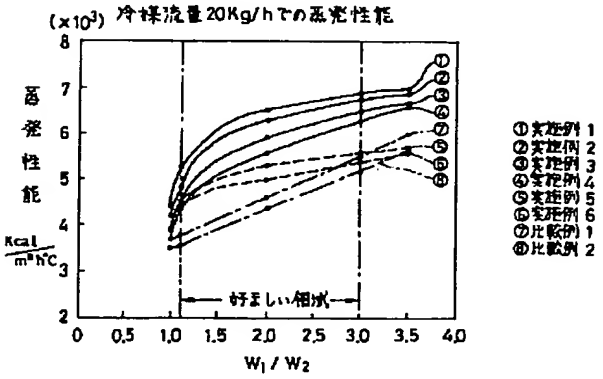
【図１】



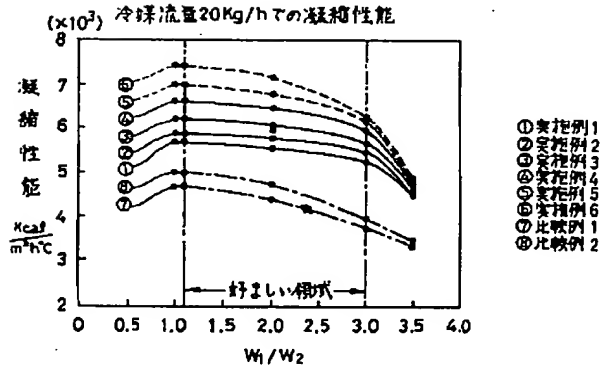
【図２】



【図３】



【図４】



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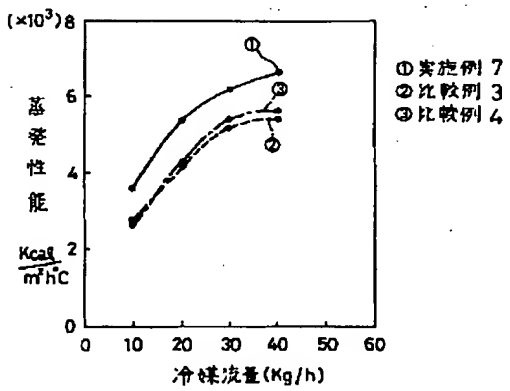
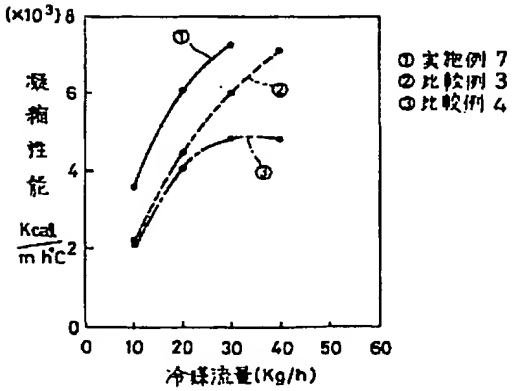


【図６】



フロントページの続き

(72)発明者　野口　昌孝
神奈川県秦野市平沢65番地　株式会社神戸
製鋼所秦野工場内

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the front view of the heat exhanger tube with a internal-surface-of-parietal-bone slot concerning the example of this invention.
[Drawing 2] It is the development of the heat exhanger tube in which the shape of the quirk is similarly shown.
[Drawing 3] It is the graphical representation showing evaporability ability.
[Drawing 4] It is the graphical representation showing a condensation performance.
[Drawing 5] It is the graphical representation showing evaporability ability.
[Drawing 6] It is the graphical representation showing a condensation performance.
[Description of Notations]
1, 2:****
10: Heat exhanger tube

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the heat exhanger tube with a internal-surface-of-parietal-bone slot with which the energy-saving service condition with few refrigerant flow rates also has high temperature convertibility ability about the heat exhanger tube with a internal-surface-of-parietal-bone slot used for heat exchangers, such as a room air-conditioner.
[0002]
[Description of the Prior Art] What two or more sorts of slots were formed [what] in the internal surface of parietal bone of a metallic conduit, and raised the heat-exchange performance as a heat exhanger tube with a internal-surface-of-parietal-bone slot used for heat exchangers, such as a room air-conditioner, is well-known (JP,3-13796,A, JP,4-158193,A).
[0003] The heat exhanger tube in which it makes it come in JP,3-13796,A among such conventional techniques to form the spiral slot which has the angle of the reverse sense mutually to a tube axis in the type where the inner circumference of a spool is divided into a spool internal surface of parietal bone with four or more even numbers is indicated. And while the aforementioned spiral slot is formed at constant pitch, the flat part which does not have a slot at a spacing suitably is prepared in the orientation of a tube axis. In this conventional heat exhanger tube with a internal-surface-of-parietal-bone slot, the degradation resulting from an inversion of the slot by hairpin manipulation is prevented, the liquid thickness in a spool equalizes by **** operation of the condensate at the time of condensation, secession of the liquid from a slot intersection is promoted further, and the effect that a condensation performance improves is done so.
[0004] Moreover, in JP,4-158193,A, the heat exhanger tube which formed two or more sorts of concavo-convex groups in the spool internal surface of parietal bone by predetermined width of face along the orientation of a tube axis is indicated. This concavo-convex group has parallel irregularity, and a protruding line and a slot are located by turns. Moreover, the concavo-convex group of 1 and the concavo-convex group which adjoins the concerned concavo-convex group differ in any one or more element in each element of a lead angle to a slot pitch, a slot dimension, the shape of a quirk, and the orientation of a tube axis of a slot. Furthermore, the case where the aforementioned concavo-convex group sets or more to three is indicated. In this conventional technique, the disturbance of the flowing of the refrigerant in a spool is carried out, and the effect of raising heat-conducting characteristic ability is indicated.
[0005]
[Problem(s) to be Solved by the Invention] However, there is a fault shown below in such conventional techniques. First, in JP,3-13796,A, when the spiral slot which has the angle of the reverse sense mutually is prepared in a heat exhanger tube and it is used as an evaporator by the service condition with few refrigerant flow rates, refrigerant liquid does not spread uniformly in [whole] a spool, but there is a trouble where a heat-exchange performance falls.
[0006] Moreover, also in JP,4-158193,A, if it is used as an evaporator by the service condition with few refrigerant flow rates when the spiral slot which has the angle of the reverse sense mutually is prepared in a heat exhanger tube, it will not spread uniformly [refrigerant liquid] in [whole] a spool, but a heat-exchange performance will fall. On the other hand, when the spiral slot which has the angle of the same orientation is prepared, the **** effect of a condensate falls at the time of condensation, the heating surface is being worn by the condensate, will become thermal resistance, and a heat-exchange performance will be reduced.
[0007] this invention is made in view of such a trouble, and it aims at offering the heat exhanger tube with a internal-surface-of-parietal-bone slot which can obtain a high heat-exchange performance under the energy-saving service condition with few refrigerant flow rates.
[0008]

[Means for Solving the Problem] In the heat exhanger tube with a internal-surface-of-parietal-bone slot manufactured by the heat exhanger tube with a internal-surface-of-parietal-bone slot concerning this invention carrying out the rolling molding of two or more slots in one field of ******** material, ****ing this slot forming face inside, fabricating it tubular, and carrying out the weldbonding of the comparison edge While the twist angles to the orientation of a tube axis differ, two or more sorts of ****s from which the twist orientation is different are arranged by turns to the field of the width of face which is different in a spool circumferencial direction, the aforementioned slot is twisted in the field where the aforementioned width of face is wide, and an angle is characterized by forming the parvus slot.
[0009] When the aforementioned **** is two kinds, it is desirable to set width of face of the field with wider width of face to W1/W 2= 1.1 or 3.0, when width of face of the field with narrower W1 and narrower width of face is set to W2. In addition, these W1 and W2 are a circumference in the spool internal surface of parietal bone in which the slot was formed.
[0010] Moreover, when the aforementioned **** is made into two kinds, as for the aforementioned twist angle, it is desirable that the method of the parvus is [4 or 20 degrees, and the larger one] 15 or 90 degrees.
[0011] In the invention in this application, since refrigerant liquid tends to spread in [whole] a spool and also produces the turbulent flow effect further at the time of vaporization by distributing by turns two or more kinds of ****s from which the degree of torsion angle to the orientation of torsion and the orientation of a tube axis of a slot is different to the field in which width of face is different in a spool circumferencial direction, the heat-exchange performance in which the service condition with few refrigerant flow rates is also high is obtained.
[0012] On the other hand, a **** operation of a condensate arises at the time of condensation, the heating surface always contacts a refrigerant gas, and continuous condensation occurs. Furthermore, in the fraction with a large twist angle, since the liquid issue by gravity is promoted, a high heat-exchange performance is obtained also on the conditions with few refrigerant flow rates.
[0013]
[Embodiments of the Invention] Hereafter, the example of this invention is concretely explained with reference to an accompanying drawying. The front view of the heat exhanger tube with a internal-surface-of-parietal-bone slot which drawing 1 requires for the example of this invention, and the drawing 2 are developments of the heat exhanger tube in which the internal-surface-of-parietal-bone slot is shown. Two kinds of ****s 1 and 2 are formed in the internal surface of parietal bone of a heat exhanger tube 10. That is, as shown in drawing 2 , a torsion angle [as opposed to the orientation of a tube axis in **** 1] is the aggregate of a parvus slot, and **** 2 is the aggregate of the slot where the torsion angle to the orientation of a tube axis is bigger than **** 1. These ****s 1 and 2 are formed in the field of W1 and W2 (W1> W2) with the circumference in a spool internal surface of parietal bone at the spool circumferencial direction, respectively. Moreover, as shown in drawing 1 , the slot pitch of the spool circumferencial direction of **** 1 is the parvus from the slot pitch of the spool circumferencial direction of **** 2. Although each **** 1 and 2 is arranged by turns at the spool circumferencial direction, it is continuously formed in the orientation of a tube axis. However, in order to connect a fin with a heat exhanger tube 10, the flat part which does not have a slot at a spacing suitably may be prepared in the orientation of a tube axis.
[0014] The shape of such a quirk imprints the shape of a quirk which is shown in drawing 2 by rolling molding to one field of a metal strip plate, can carry out the slot forming face inside, can fabricate this metal strip plate tubular, and can manufacture it by carrying out the weldbonding of the matching edge further.
[0015] Next, an operation of the constituted heat exhanger tube with a internal-surface-of-parietal-bone slot is explained like ****. First, when using a heat exhanger tube as an evaporator, refrigerant liquid is supplied in a heat exhanger tube. Then, if the slot where a configuration element (a slot pitch, the degree of torsion angle, or the orientation of torsion) is different in a heat exhanger tube internal surface of parietal bone is distributed by the manipulation width of face which is different in a spool circumferencial direction as shown in drawing 2 , refrigerant liquid is influenced of the shape of a quirk with the wide manipulation width of face of a circumferencial direction, and it becomes the revolution style in alignment with the twist angle of the concerned slot, and it will spread in the whole heat exhanger tube wall, and evaporability ability will become high
[0016] In this case, since the twist angle over the orientation of a tube axis of the slot in the slot formation field where width of face is wide is accompanied by the turbulent flow in the field where the width of face from which it is easy to produce a revolution style also under the low rate-of-flow condition with few parvus and the flow rates of refrigerant liquid, and the shape of a quirk is further different is narrow, high evaporability ability is obtained.
[0017] On the other hand, when using a heat exhanger tube as a condenser, a refrigerant gas is supplied in a heat exhanger tube. A refrigerant gas is condensed and liquefied by the whole heat exhanger tube wall. As for the

condensate in early stages of liquefaction, for a parvus reason, at this time, a revolution style is suppressed for the inertia of flowing by the slot of the slot formation field where width of face is narrow. Consequently, it is prevented that the condensed liquid is wearing the whole heating surface, the heating surface always contacts a refrigerant gas, continuous condensation produces it, and a condensation performance becomes high.

[0018] In this case, in the field where the twist angle of a slot is large, it is tended to discharge gravity a condensate at the lower part side of a heat exhanger tube, and the condensation performance in which it is high also under the low rate-of-flow condition with few flow rates of refrigerant liquid is obtained.

[0019] If it **s and W1 and the aforementioned width of face of a narrow field are set to W2 for the aforementioned width of face of the slot formation field where the width of face of a spool circumferencial direction is wide, W1/W2 will be offset less than by 1.1 by the slot where orientation is [a refrigerant style] different under the condition with few refrigerant rates of flow at the time of vaporization, it will be hard coming to generate a revolution style, and evaporability ability will fall. On the other hand, if W1/W2 exceed 3.0, at the time of condensation, it will become easy to produce the revolution style of a condensate along the slot of the slot formation field where width of face is wide, burying of the heating surface will arise, and a condensation performance will fall. Therefore, as for W1/W2, it is desirable that it is 1.1 or 3.0.

[0020]

[Example] Hereafter, the heat exhanger tube with a internal-surface-of-parietal-bone slot of this invention is actually manufactured, and the result which compared the heat-conducting characteristic ability with the example of a comparison which shifts from this invention is explained. On one front face of a copper plate, the slot of the shape of a trapezoid which set the slot pitch in the depth of 0.2mm, and a slot right-angled cross section to 0.2mm The manipulation width-of-face ratio of a spool circumferencial direction was made to correspond in the orientation of the board width, and W1/W2 made 3 degrees, 7 degrees, 20 degrees, and the twist angle of the slot of the field of width of face W2 15 degrees, 20 degrees, 60 degrees, and 90 degrees for 1.0-3.5, and the twist angle of the slot of the field of width of face W1, and they prepared the field of W1, and three pairs of fields of W2. Roll rolling performed molding of a slot, after that, the recessing side was carried out inside, crosswise, the board width edge was compared with slight roundness, the plate was welded, and the heat exhanger tube with an outer diameter of 7.0mm was manufactured.

[0021] The above-mentioned heat exhanger tube has been arranged inside a double tube-type heat-exchange machine with a length of 3000mm, conduction of the refrigerant was carried out into the spool of a heat exhanger tube, conduction of the water was carried out to the annular section between a heat exhanger tube and an outer tube, it carried out the heat exchange to it, and heat-conducting characteristic ability was measured.

[0022] With the heat exchanger using the copper tube with an outer diameter of 7.0mm, although the refrigerant flow rate at the time of rated-capacity operation was about 30kg/h, it carried out this time by the refrigerant flow rate of 20kg/h below a rated condition.

[0023] It is the graphical representation drawing 3 shows an evaporative test, drawing 4 shows a condensation test result, all take W1/W2 along a quadrature axis, drawing's 3 taking evaporability ability, and drawing's 4 taking a condensation performance along an axis of ordinate, and showing each performance. In drawings 3 and 4, the example 1 or 6 and the example 1 of a comparison, or 2 has the twist angle (W1 section and W2 section) shown in the following table 1.

[0024]

[Table 1]

		W_1部振れ角（°）	W_2部振れ角（°）
実施例	1	7	15
	2	7	20
	3	7	60
	4	7	90
	5	20	60
	6	20	90
比較例	1	3	15
	2	3	60

[0025] If W1/W2 exceed 1.1 at the time of vaporization so that clearly from drawing 3 , a revolution style will arise in a refrigerant and a performance will improve rather than the case where W1/W2 are 1.0. When a slot formation field was twisted to the large field of W1 and the slot whose angle is 7-20 degrees had been arranged especially, high evaporability ability was shown.
[0026] If width of face is twisted to the large slot formation field 1 on the other hand and the slot whose angle is 30 degrees is arranged, evaporability ability will fall rather than the above-mentioned case. This cause is because it was hard coming to generate the revolution style of a refrigerant and it will be easy being got dry by the heat exhanger tube upper part under the condition with few refrigerant flow rates, when a twist angle is as large as 30 degrees.
[0027] On the other hand, degradation will become remarkable, if W1/W2 maintain a high performance in the 3.0 or less domain at the time of condensation and W1/W2 exceed 3.0 so that clearly from drawing 4 . When width of face was twisted to the large slot formation field W1 at the time of condensation and the angle had arranged the large slot, it is in the inclination that a high condensation performance is obtained, and the case where it was twisted to this field and the slot whose angle is 30 degrees had been arranged showed the highest performance.
[0028] The latest air-conditioner has air conditioning combination in use, and, as for both the performances of a heat exhanger tube, what has the high both sides of vaporization and condensation is demanded. For this reason, it is desirable to set width of face of the slot formation field with the wider width of face of the above-mentioned example to a spool circumferencial direction to W1/W2=1.1-3.0, when setting width of face of W1 and the slot formation field of the narrower one to W2, and to make 4-20 degrees and the degree of slot torsion angle of a narrow field into 15-90 degrees for the slot twist angle of a large field by the torsion of an opposite direction.
[0029] About W1/W2, in order for both vaporization and condensation to obtain a high performance, it is good to be preferably referred to as W1/W2=1.5-2.5. The drawing 5 and the drawing 6 are graphical representations taking evaporability ability or a condensation performance along an axis of ordinate, taking a refrigerant flow rate along a quadrature axis, and showing the result of an evaporative test and a condensation examination, respectively. The example 7 shown all over drawing and the examples 3 and 4 of a comparison have the twist angle (W1 section and W2 section) shown in the following table 2.
[0030]
[Table 2]

		W_1部振れ角	W_2部振れ角	W_1／W_2
実施例	7	右7°	左60°	2．0
比較例	3	右15°	左15°	1．0
	4	右15°	右15°	1．0

[0031] As shown in drawings 5 and 6, the example 7 of the invention in this application is excellent in each of

evaporability ability and condensation performances as compared with the examples 3 and 4 of a comparison from which W1/W2 separate from the domain of a claim 2.
[0032] As mentioned above, the refrigerant flow rate at the time of rated-capacity operation was conventionally designed by heat exchangers, such as an air-conditioner using the copper tube with an outer diameter of 7.0mm, by h in about 30kg /. However, the power load reduction of a compressor is recently demanded from the point of energy saving and efficient-izing. In this case, although it is necessary to obtain the conventional rated capacity in the service condition with few refrigerant flow rates, since a high performance is obtained like **** under a few service condition called 20kg/h in a refrigerant flow rate, the heat exhanger tube with a internal-surface-of-parietal-bone slot concerning the invention in this application makes a remarkable contribution to energy saving and efficient-izing of a heat exchanger.
[0033]
[Effect of the Invention] As explained above, if the heat exhanger tube with a internal-surface-of-parietal-bone slot concerning this invention is used for heat exchangers, such as a room air-conditioner, the heat-exchange performance in which it is high also under the energy-saving service condition with few refrigerant flow rates will be obtained. For this reason, this invention makes a great contribution at the request of energy saving of the latest heat exchanger, and efficient-izing.

[Translation done.]